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Abstract: OvoControl G is a relatively new product that reduces the hatchability of Canada goose (*Branta canadensis*) eggs. However, little data is available on the cost of application. We present a model for estimating the cost of application of OvoControl G for managing nuisance Canada goose populations. We found that at low goose densities, fixed labor costs are responsible for a significant portion of the cost. As goose densities increase, these fixed costs become equivalent to, and eventually less than, the costs associated with the purchase of the product. We present several scenarios that managers may employ to further reduce the cost of application.

Key words: biocontrol, *Branta canadensis*, Canada geese, cost analysis, OvoControl, population control

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Over the last 20 years, resident Canada goose (*Branta Canadensis)* populations have increased to the point they have become problematic for city managers, golf course operators, residents, farmers, and others (Conover and Chasko 1985). Resident Canada geese are defined as non-migratory Canada geese that nest and reside predominantly within the United States. Overabundant resident goose populations create numerous problems including but not limited to: threats to human health through fecal contamination of beaches and other public areas, threats to human safety from birdstrikes, threats to other wildlife through disease transmission, attacks and hazards as geese defend their nesting sites, and damage to property, natural resources and quality of life (USDA 1999).

Contraceptives have long been touted as a humane method that will solve the problems of wildlife damage management (Rutberg 2005). Currently, however, there is no single dose contraceptive that has been shown to be effective for large scale wildlife management. In nuisance goose management, there are several techniques that have been used for years that approximate the effects of contraceptives by limiting the hatch rate of eggs, such as destroying nests, egg oiling, egg addling, puncturing, and egg replacement (Cooper and Keefe 1997, Smith et al. 1999). Recently, a new product, OvoControl G, was developed for reducing the hatchability of eggs in nuisance populations of Canada geese.

The active ingredient of OvoControl G is nicarbazin. Nicarbazin has been used since the 1950s as an anticoccidial in broiler chickens (Jones et al. 1990). It was determined that if nicarbazin was fed to breeding poultry, the hatchability of eggs was reduced. Nicarbazin interferes with the formation of the vitelline membrane, which allows the yolk to intermix with the albumen of the egg. This action prevents the fertilized egg from further development. The National Wildlife Research Center (NWRC) has conducted laboratory and field trials with a nicarbazin-based product to control nuisance waterfowl (Johnston et al. 2001, Bynum et al. 2005). In 2005, Innolytics LLC, Rancho Santa Fe, CA, obtained Environmental Protection Agency (EPA) approval to produce OvoControl G for nuisance goose management. Because this is a relatively new product, little data is available on the application costs for controlling Canada goose populations. Calculating the economic efficiency of the broad scale application of this product necessitates the development of a model for determining the factors affecting the costs associated with OvoControl G. In specific, the determination of the total application cost per egg (TC_E) to control nuisance geese will provide the information necessary to ascertain if this product is economically efficient.

METHODS

The TC_E associated with the use of OvoControl G is a combination of the total amount of labor (L_T) plus the amount of OvoControl or material (M_T) used, divided by the number of eggs (E_S). We used an estimate of 5.1 eggs per pair of geese per season (Cooper and Keefe 1997).

When applying OvoControl G, a suitable site is selected where the birds can be fed without disturbance. This site is located in late winter or early spring, prior to nesting season (the period when the birds begin pairing off and laying eggs; Figure 1). The birds are then fed a small amount of OvoControl G (initially 25% of the full dosage) to acclimate them to feeding in the area, assess bait acceptance, and determine which non-targets (if any) are also in the area. This "acclimation period" lasts for 21 days prior to the start of the nesting season. This is similar to the pre-baiting period used in toxicant applications (e.g., DRC-1339); however, there is no untreated pre-bait. The OvoControl G product is used throughout the project. During this acclimation period, the amount of OvoControl G is increased slowly (25% increase per week) until the end of the acclimation period where the birds are on the full treatment dosage of 28.3 g per goose per day (Figure 1). The subsequent period is the treatment period. This period lasts for as long as the birds are present during the nesting season and are consuming bait. The levels of L_T and M_T are in relation to either the acclimation or treatment periods (Figure 1).

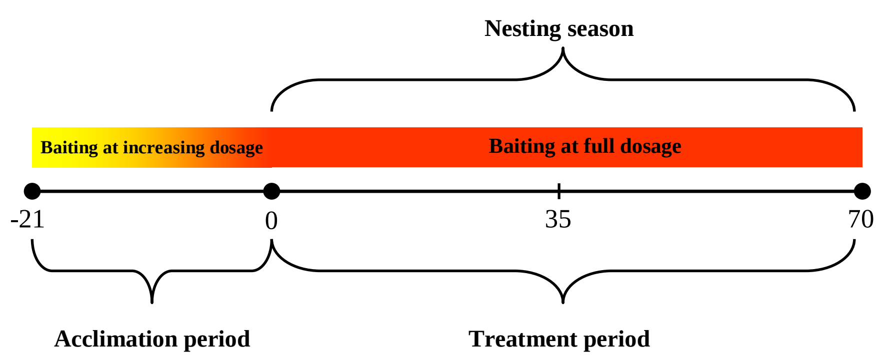

Figure 1. Timeline of acclimation and treatment periods.

Cooper and Keefe (1997) provided an estimate for labor costs for conducting similar Canada goose work as $14.31 in 2007 US dollars. However, there is not an estimate for labor or wage rate (W) that would be a typical price for this type of activity, therefore, in addition to the estimate provided by Cooper and Keefe (1997), our study incorporated the 2007 hourly rate for a GS-5 ($16.58), GS-7 ($20.53), and GS-9 ($25.11) level (Step 1 base hourly rate + 35% for benefits) federal wildlife biologist or technician (Office of Personnel Management http://www.opm.gov/oca/07tables/pdf/gsh.pdf) to provide a range of labor costs for OvoControl G application. To determine L_T for a typical application of OvoControl G, we examined the label for time requirements. Several time requirements were used, including application time (a minimum of 1 hour per application; baiting occurs for the entire time of the nesting [treatment] period, which can last from 8-10 weeks, or until all the birds have left the nest), observation time during the acclimation period (2 hours minimum per day for the first 21 days of baiting), and observation time during the treatment period (2 hours per week of baiting during the breeding season). Table 1 provides a summary of labor time requirements. Additional observations must be conducted if uneaten bait is found from the previous day. While this scenario was not included in our calculations, it must be considered as a potential reason for underestimating labor time associated with a project.

Table 1: Associated values from the acclimation and treatment periods from an OvoControl G treatment

	Acclimation	Treatment
Observation Days	21	1/week
Hours per baiting observation day	2	0.142857
Baiting Days		35 min + 1 day per additional pair
Labor cost per hour	$10.85	$10.85
OvoControl / Bird in grams	14.15	29.3

The time required for application may change due to the number of birds present and when they lay their eggs. It was assumed that the timing of the egg laying period would have a normal distribution and that the majority of birds would breed near the middle of the breeding season (during week 5; Figure 2). Beginning at 1 pair of geese, it was assumed that the minimum time spent baiting was 35 days and the number of baiting days increased by 1 per pair of birds until a total of 70 days (the maximum number of weeks listed on the label) was reached. While it is possible that the Canada geese breeding season may extend further than the number of weeks listed on the label, most of the geese in an average population will have nested by the end of the 10-week period. Additional time for non-target observations during baiting was increased at a rate of 1 hr/wk until 70 days was reached. All the time requirements used in our calculations were based on information current as of 1 January 2007.

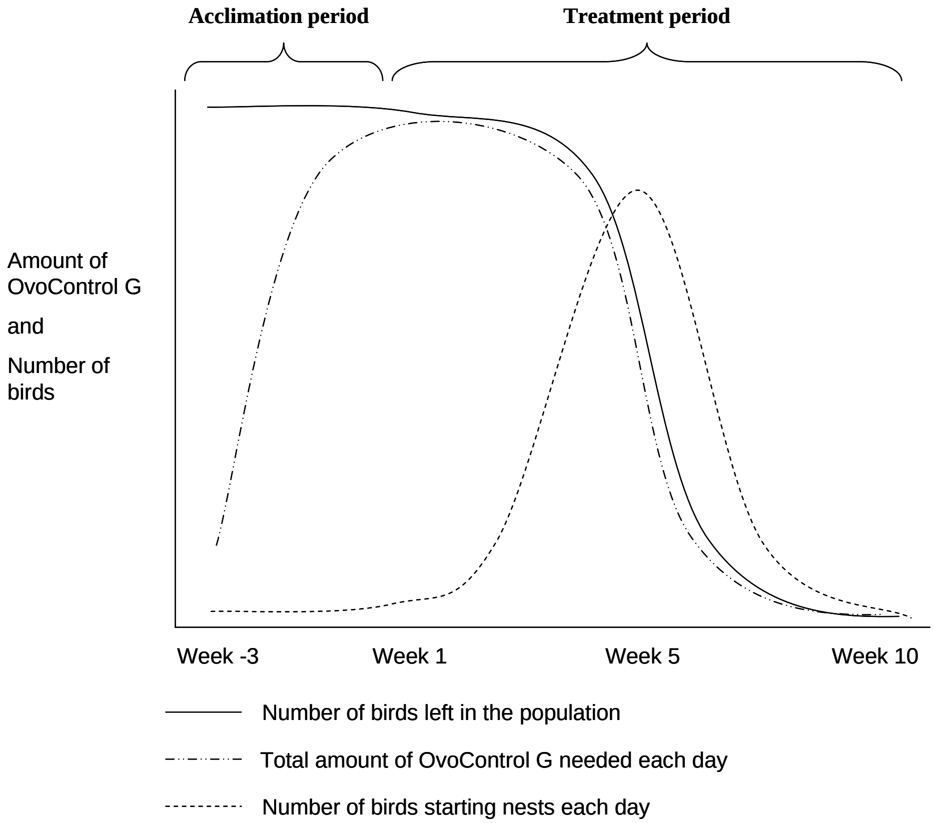

Figure 2. Graphical representation of the amount of OvoControl G required relative to the number of birds in the population and the number of bird nesting each day.

For cost of material (P_O), we used an estimated cost of $4.55 per pound ($0.01/g Erick Wolf, CEO, Innolytics, LLC, personal communication) for OvoControl G. Actual price of product may vary depending upon the quantity ordered and supplier used. Dosage rates for the treatment period (M_B) were calculated based upon the amount required by the label (28.3 g OvoControl G per goose per day for entire season). The total amount of OvoControl G or material (M_T) needed is also dependent on the time period (Acclimation vs. Treatment).

During the acclimation period, geese become slowly habituated to increasing amounts of the bait from zero at day -21 to full dosage by the beginning of the treatment period (Figure 1). Therefore, the amount of material used in the acclimation period (M_A) was on average 14.15g of OvoControl G (1/2 of the full dosage rate) for the acclimation period (21 days). Nesting pairs tend to stop feeding on the OvoControl G as the female lays her eggs (Erick Wolf, personal communication). Once the clutch is complete, the pair will stay near and not forage far from the nest, reducing the amount of OvoControl G needed each day (Figure 2). To estimate this reduction in feeding in our model, we reduced the amount of bait needed over the entire nesting season by half the number of birds present from the original population.

Therefore, determination of the total costs associated with the use of OvoControl G can be expressed in equation 1,

$$TC_E = \frac{(L_T + M_T)}{E_s} \qquad (1)$$

where,
$L_T = (L_P + L_B)W$
$L_A = 42$ *hours*
$L_B =$ *(treatment days x hr/bait day) + (treatment observation days x .142857)*
$W = \$10.85$
$M_T = (M_A + M_B)P_O$
$M_A = 14.15$ *x No. of pre-bait days*
$M_B = 28.3$ *x No. of birds x No. of bait days*
$P_O = \$4.55/lb$
$E_S = 5.1$ *x No. of pairs*

EXAMPLE APPLICATION

A typical application may involve a local golf course or housing development manager requesting help with a goose problem and identifies this problem as approximately 32 pairs of geese feeding on the property and nesting in the surrounding areas. Below are three scenarios for this application in increasing order of costs:
Scenario 1 – the golf course provides all the labor for the application;
Scenario 2 – the golf course applies the product, but contracts out for the observations;
Scenario 3 – all the labor is contracted out.

RESULTS

We estimated that the amount of labor hours needed for a typical application for 1 to 30 pairs of geese ranged from 82 to 122 hours. Assuming that flocks greater than 30 pairs of birds are small enough to feed in one area will require approximately 122 hours. At \$14.31 per hour, the estimated total cost of labor (L_T) for a typical project ranging from 1 to 30 pairs is from \$1173 to \$1746. Incorporating the labor costs (W) for a GS-9 (\$25.11), increases L_T for a typical project to between \$2,059 and \$3,063.

During a typical OvoControl G application, we estimated that M_T would be \$12.92 per pair of geese. From one pair of geese to 5 pairs of geese, the cost of treatment drops significantly. On the low range of our labor costs, \$14.31 per hour, the cost per goose drops from approximately \$233 per egg for 1 pair of geese to approximately \$52 per egg for 5 pairs of geese. At the high range of our labor costs, \$25.11, the cost per goose drops from approximately \$406 per egg for 1 pair of geese to approximately \$88 per egg for 5 pairs of geese. Figure 3 shows the cost per egg for a typical application from 6 to 200 pairs of geese when all the labor is hired from external sources. Some managers may have the ability to provide all the labor for a project. In this case, the cost per egg increases slightly from \$2.53 for 1 pair of geese to \$2.73 for 4 pairs of geese; however, the cost per egg hits a maximum of \$4.48 per egg for goose populations >30 pairs of geese (Figure 3).

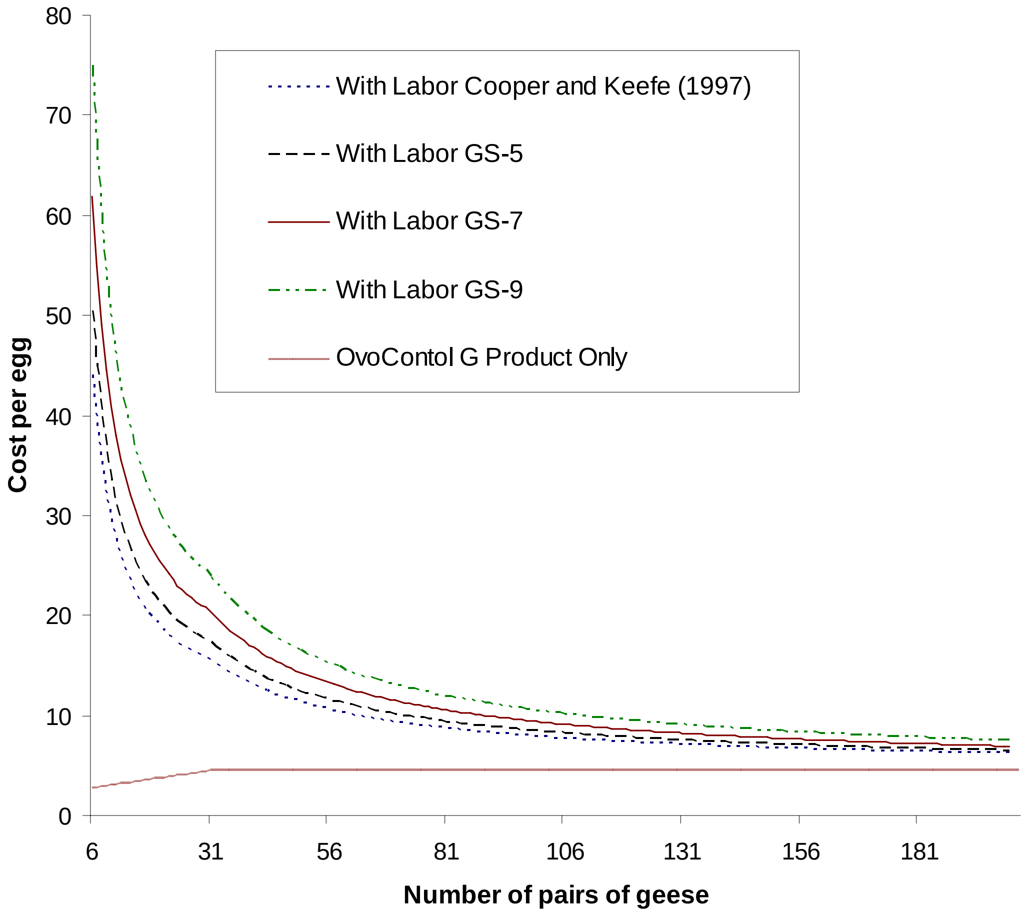

Figure 3. Cost per egg of OvoControl G treatment ranging from 4 to 200 pairs of geese using a range of labor costs.

DISCUSSION

Our model provides an estimate for OvoControl G for a range of scenarios, ranging from no labor outsourced for the application to using a wildlife biologist or technician paid a wide range of salaries. Because of the high fixed labor costs associated with an OvoControl G application, treating small populations (1 to 20 pairs of geese) may not be cost effective. However, in situations where lethal control or the perception of harming geese is unacceptable, OvoControl G may still be a viable option, regardless of the cost compared to other techniques.

During a typical application, other costs must be considered that were not taken into account during our model, such as depreciation of equipment, travel costs, and cost of completing paperwork (i.e., obtaining permits, filling out reports, etc.). However, atypical applications can cause project costs to increase significantly. Additional observations must be conducted if uneaten bait is found from the previous day. This may occur if the geese are spooked off of the food or significantly fewer geese show up to feed than expected. While this scenario was not included in our calculations, it must be considered as a potential reason for underestimating a project. Other sources of additional costs would be the presence of non-targets consistently feeding on the bait. If this occurs, then the entire process, starting with day -21 must begin again in another suitable location. If the geese cannot be moved to another feeding location away from non-targets, the application may have to be cancelled; resulting in the cooperator having to pay for a failed project or the applicator having to absorb the costs expended.

Labor costs are a major factor affecting the cost effectiveness of OvoControl G (Figure 1). Because OvoControl G is registered with the EPA as a restricted-use pesticide, the label dictates the minimum amount of time required during a typical application. Much of the time required occurs during the habituation period when the licensed applicator conducts observations for non-targets and how well the geese are accepting the product (2 hr per day for 21 days). Even if a municipality, golf course, or other area has existing personnel who can apply pesticides, during the habituation phase, they will have to take 2 hours out of each of their day (including weekends) to apply the bait and make the observations. During the baiting phase, the amount of time can be reduced by using existing personnel. Once the bait is eaten, the applicator can go about their other duties. External contractors will usually require a minimum time commitment each day, so it typically will not affect the price if the bait is eaten quickly.

The state pesticide regulation agencies may also place additional restrictions on applicators beyond those listed on the federal label. Therefore, time requirements may be higher in some states. The pesticide regulation and state wildlife agencies may also require that the applicator have a specific level of experience with wildlife, further restricting who may apply OvoControl G to nuisance Canada geese. It is important to consult with all of the agencies involved before completing an estimate for OvoControl G as part of a nuisance Canada goose management plan.

Community-based wildlife management programs may rely on volunteers to harass birds, enforce no-feeding policies, monitor population size, and conduct other aspects of a wildlife damage management plan. To reduce the price of an application, managers and administrators may desire to use volunteers in the application and observation phases. However, the state agency responsible for pesticide application must be contacted to determine if this is possible under state law. Some states may allow volunteers who are trained in specific procedures to apply the OvoControl G under the off-site supervision of a licensed applicator. Other states may require that only the licensed applicator and those under their direct supervision apply pesticides.

Labor costs represent a significant part of a typical OvoControl G application. Therefore, anything that wildlife damage managers can do to reduce the amount of labor may result in a significant savings to the cooperator. However, it is important for the applicator to have a thorough understanding of the state pesticide application laws so that any changes to the application process (i.e., using volunteers or on-site personnel) are within the law.

While these costs may initially appear cost prohibitive to some cooperators, they may be equivalent to other methods. VerCauteren et al. (2006) stressed the importance of examining the cost effectiveness of wildlife damage control methods. The actual cost of application, even with all of the labor supplied externally, may be less than other acceptable methods or less than the amount of damage being caused. The next step of this process should involve comparing the cost of

OvoControl G application to other techniques to determine the relative cost effectivenss.

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